

## **Reading Strategy Instruction in Secondary Agricultural Science Courses: An Initial Perspective**

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### **Abstract**

*Students must be able to create meaning from career and technical education texts. Reading and comprehension of texts are skills that develop through practice with a variety of texts, including those in career and technical education. A quasi-experimental nonequivalent control group design was used to determine the effect of implementing content area reading strategies (CARS) on comprehension and reading behaviors of a purposively selected sample ( $n = 95$ ) of secondary agricultural science students. Instruction with CARS was compared to the teacher's normal instructional routine. Pretest score, grade level, grade point average, gender, ethnicity, and standardized reading level predicted 65% of variance in agriculture posttest scores. Students in the treatment group generally improved their reading behaviors, while students in the comparison group regressed. Students in the treatment group read significantly more hours per week for school and had increased the hours reading for pleasure significantly more than the comparison group.*

### **Introduction**

Adolescents need strong reading skills to excel in academics, create meaning from text, and function in society (Forget & Bottoms, 2000; Meltzer, 2001). These reading skills are vital for productive careers, democratic citizenship, and successful personal lives (D'Arcangelo, 2002; Guthrie, Schafer, Wang, & Afflerbach, 1995; National Reading Panel [NRP], 2000; Vacca, 2002b). High school graduates must possess skills necessary for understanding, creating, and applying meaning from text (Snow, 2002); therefore, reading must occur in not just the core academic areas, but in secondary agricultural sciences and career and technical education areas as well. Yet, agricultural science teachers and other career and technical education teachers implement few content area reading strategies in their courses (O'Brien & Stewart, 1990; Park & Osborne, 2006). Further, little research of an experimental nature has been conducted regarding the development of reading skills in secondary agricultural sciences or other career and technical education areas.

While little explicit literacy instruction occurs in many career and technical education courses, the need for such instruction may be more applicable than in any other course. When students do not comprehend a literary work in English class, the consequence is failure on an assignment or assessment. However, when a student does not comprehend text in agricultural science, such as a chemical label, a technical manual, or a nutritional label, the consequences may include failure on an assignment or test, but may also actually endanger the student or his/her peers. Misunderstanding a chemical label or even a simple ruler, at the least will cause economic loss of plant life in a greenhouse or wastage of construction materials. Thus, the consequences of students' reading failures in career and technical education are real and may have dire impacts.

The problem associated with the use of literacy strategies in career and technical education is the lack of evidence supporting the impact of such strategies on students' academic performance and motivation. While the literature would suggest that the use of reading strategies will assist students in learning about concepts and enhance motivation to read, little research supports these conclusions in career and technical education. The purpose of this research, therefore, was to address the need for empirical research that identifies the impact of content area reading strategies on students' reading comprehension and motivation to read.

### **Problems and Challenges of Reading Deficiencies**

Literacy improvement is seldom a solitary event. In order to improve reading skills, students must be exposed to texts and thinking in all educational contexts. This includes the application of texts and reading as tools for learning and thinking in agricultural science education and other career and technical education areas. Improving reading and literacy skills is the job of every teacher, not just those in the language arts. In order for students to succeed in making decisions within the complex, information-based world, it is vitally important that they possess the ability to create knowledge from text, analyze arguments, propose solutions, and make decisions about real-world issues (Alvermann, 2006; National Governors Association [NGA], 2005). Yet, again, agricultural science teachers do not explicitly instruct students with reading strategies (Park & Osborne, 2006).

The problems of reading skill deficiency are prevalent at the secondary level. In the 8<sup>th</sup>-grade, 32% of boys and 19% of girls cannot read at the basic level (National Center for Educational Statistics [NCES], 2001), meaning that these students cannot understand texts, make interpretations, or relate concepts from the text to the classroom or real life. At the 12<sup>th</sup>-grade, 26% of all students fail to read at the basic level, including 30% of boys and 17% of girls (NCES, 2001; Wirt et al., 2004). Educators are making little advancement in teaching students how to comprehend and apply text, especially for struggling readers (Cappella & Weinstein, 2001; NCES, 2001). In 2004, Florida students showed improvement at every grade

level, except grades eight and 10, where the number of students reading below grade level increased from 62% in 2001 to 66% in 2004, the highest level in four years (Florida Department of Education [FDOE], 2004b, 2004c).

Eight percent of career and technical education concentrators improved their reading scores on the National Assessment of Educational Progress (NAEP) between 1994 and 1998 (NCES, 2001). Yet, only 29.3% of these students who completed three or more years of secondary career and technical education read at or above the *proficient* level (Silverberg, Warner, Fong, & Goodwin, 2004). The improvement in reading scores amounted to eight points, or just less than one standard deviation. A similar study of vocational completers within *High Schools That Work* schools found nearly a six-point improvement in reading achievement from 1996 to 1998 (Kaufman, Bradby, & Teitelbaum, 2000). However, the unknown variable is whether the completion of additional career and technical education courses or additional academic courses affected the improvement in reading achievement. At the same time, 44.8% of non-concentrators read at or above the proficiency level. Further, the report suggested, "There is little evidence that vocational courses contribute to improving academic outcomes" (Silverberg et al., p. 7).

Reading in secondary schools and content areas, such as career and technical education, is vital to students' development of comprehension skills. However, many students lack the requisite skills to understand and apply meaning from texts. Therefore, they disengage with reading in content areas and for pleasure. Students' reading difficulties are compounded by the diversity and complexity of reading material encountered in career and technical education courses (Alexander & Kulikowich, 1991; Cresson, 1999; Digisi, 1993; Kim, Vaughn, Wanzek, & Wei, 2004; Menke & Davey, 1994; Vacca, 2002a). Content area texts often contain complex and difficult vocabulary, structure, and concepts (Kim et al, 2004), which is especially true for career and technical education texts. The reading activities are also demanding and involve problem solving and critical thinking. Teachers are often unprepared to teach reading strategies and do not employ reading on a regular basis (Bintz, 1997; Cresson, 1999; Digisi, 1993; Menke & Davey, 1994). As the context of reading in secondary schools shifts with each passing period, students are required to shift knowledge, thinking skills, and contexts in order to comprehend coursework. Additionally, students often fail to realize the connection between reading in content areas and applications in their personal lives.

Good instruction is the most effective means of increasing student comprehension and developing skilled readers (Snow, 2002; Tomlinson, 1995). Because many career and technical education areas use difficult and complex text, the responsibility for teaching or at least reinforcing reading strategies belongs to all teachers in all subjects, including career and technical education (Alexander & Kulikowich, 1991; Florida Department of Education [FDOE], 2004a; Vacca, 2002a). However, few teachers employ reading strategies in their classrooms (Barry, 2002; Bean, 1997; Durkin, 1978; Ivey, 2002; Menke & Davey, 1994; Morawski &

Brunhuber, 1995). While researchers have cited various reasons, including lack of preparation, lack of time, and denial of responsibility (Bean, 1997; Bintz, 1997; Durkin, 1978; Forget & Bottoms, 2000; Stewart, 1990; Stewart & O'Brien, 1989; Vaughn, Klinger, & Bryant, 2001), perhaps part of the lack of content area reading strategies (CARS) implementation stems from teachers not being convinced of the efficacy of CARS with actual data from their own classrooms.

## **Theoretical and Conceptual Framework**

### **Sociocultural Theory of Reading**

Comprehension is more than just individual students and their reading; it is socially constructed through reading, writing, and speaking. Contextualized within the individual's social networks and their learning communities (Moje, 1996), reading is a social activity among students as they collectively construct content and learning procedures (Rex, 2001). Reading occurs socially as students "discuss their personal relationships to reading in the discipline, the cognitive strategies they use to solve comprehension problems, the structure and language of particular types of texts, and the kinds of knowledge required to make sense of reading material" (Schoenbach, Braunger, Greenleaf, & Litman, 2003, p. 136).

Reading occurs within personal, sociocultural, and political contexts (Mann, 2000). These contexts include agricultural science and other career and technical education areas. Students are social beings with aspirations who contextualize and make particular pieces of information significant while reading. Social patterns in the classroom shape the volume and breadth of student reading (Guthrie et al., 1995). Reading activities are highly associated with social interactions among friends and family, strategies for comprehension and learning, classroom instruction, and teachers' emphasis on reading (Guthrie et al.). Moje (1996) posited that teachers and students construct meaning through interactions with each other, the text, and reading strategies, and these interactions are based on past experiences, current situations, and future implications.

The RAND Reading Study Group's (Snow, 2002) research agenda for comprehension provided the conceptual framework for this study. The group defined comprehension as, "the process of simultaneously extracting and constructing meaning through interaction and involvement with written language" (p. xiii). It is composed of the reader, text, and activity, or purpose for reading, which occur in a larger sociocultural context, including the teacher (see Figure 1). The teacher influences, or can influence, the reading activity by teaching CARS to readers and by encouraging students' use of CARS within classroom reading.

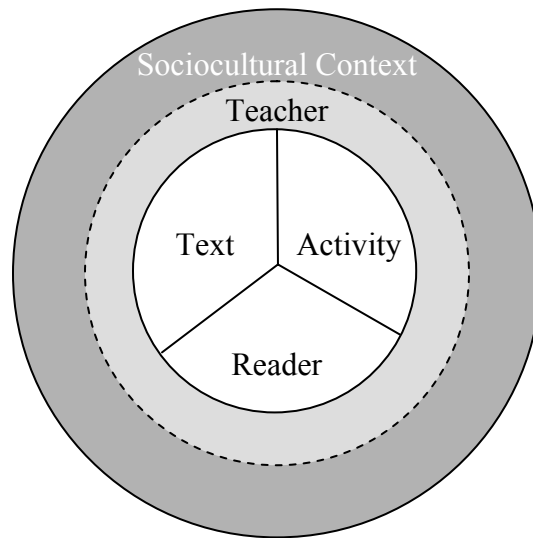


Figure 1. A Heuristic for Thinking about Reading Comprehension<sup>1</sup>.

The reader in career and technical education brings his or her cognitive capabilities, motivation, knowledge, and experiences to the reading processes (Snow, 2002). Reader characteristics include gender, ethnicity, socioeconomic status, prior grade point average, grade level in school, and reading comprehension ability. These characteristics vary from reader to reader and significantly impact the understanding of written material. For many career and technical education students, especially those who are alienated from other academic areas, reading may present challenges that are difficult to overcome. Further, career and technical education students approach these classes with a negative attitude towards reading, often believing that reading has no place in career and technical education courses. Teachers reinforce this notion by professing the *hands-on* approach to instruction in career and technical education (O'Brien & Stewart, 1990).

The text includes the representation of information, including the surface code, text base, and mental models (Snow, 2002). Each different text varies in readability, vocabulary, structure, and content, thereby, impacting comprehension. Texts within career and technical education may include traditional textbooks, trade magazines, the Internet, technical manuals, business forms, chemical labels, and machinery.

<sup>1</sup> Snow, C. (2002). *Reading for understanding: Toward an R&D program in reading comprehension*. Santa Monica, CA: The RAND Corporation.

Each of these different genres in career and technical education presents specific challenges for students' comprehension.

The activity of reading involves the purposes, operations of reading, and outcomes of the reading comprehension processes (Snow, 2002). The activity of reading in career and technical education and agricultural science can be especially problematic for students. Within the context of career and technical education and agricultural science education, students must not only read with enough comprehension to score well on pencil-and-paper tests, but also create meaning from multiple text genres and *apply* that information to solve problems. The multiplicity of genres and application of comprehension present unique problems for those who cannot comprehend well. Outcomes of reading in career and technical education can consist of solving problems, increasing knowledge, or engaging the reader.

The context of reading comprehension is comprised of the larger sociocultural environment the student encounters and navigates while reading (Snow, 2002). This sociocultural context includes the teacher, but also extends beyond the classroom to encompass the community and world of the student. It involves social aspects of constructing meaning and the development of power within society.

Within the *activity* of reading, three points occur where students metacognitively think about the reading processes and, therefore, can initiate reading strategies: before reading, during reading, and after reading (see Figure 2, Ryder & Graves, 1994). The three micro-periods of pre-reading, reading, and post-reading constitute microdevelopmental processes (International Reading Association, 1988; Snider, 1989; Snow, 2002), where the reader develops and is developed by his or her application of previous knowledge, reading skills, and comprehension. Prior to reading, students can circumvent habits that inhibit comprehension and teachers can provide scaffolding to assist learning with text, such as establishing a purpose for reading, activating prior knowledge, and developing guiding questions for reading. Strategic learning during reading involves monitoring reading and making sense of the passages. During reading, readers should question the author's meaning of the passage, his or her intent, and challenge the author's point of view. After reading, students can extend and elaborate on the author's ideas. At this stage, students share their ideas about the reading through discussion, writing, or other means of expression.

### **Empirical Research on Reading Strategy Instruction**

Instruction of reading strategies has been shown to have a positive effect on reading comprehension and motivation (Autrey, 1999; Choochom, 1995; Cooper, 1998; Druitt, 2002; Ferguson, 2001; Guthrie, 2001; Guthrie & Alao, 1997; Hurst, 2004; Knoll, 2000; Kuehl, 2002; Laflamme, 1998; Little, 1999; Lynch, 2002; Mastropieri, Scruggs, & Graetz, 2003; Rush, 2000; Sanchez, 2003; Ward-Washington, 2002). Teaching reading strategies improves awareness and use of

strategies, as well as motivation to read (NRP, 2000). However, students seldom expend the time and effort to implement strategies and do so only when directed by teachers (Cuevas, 2003). Teachers in agricultural science education seldom direct students to implement CARS (Park & Osborne, 2006).

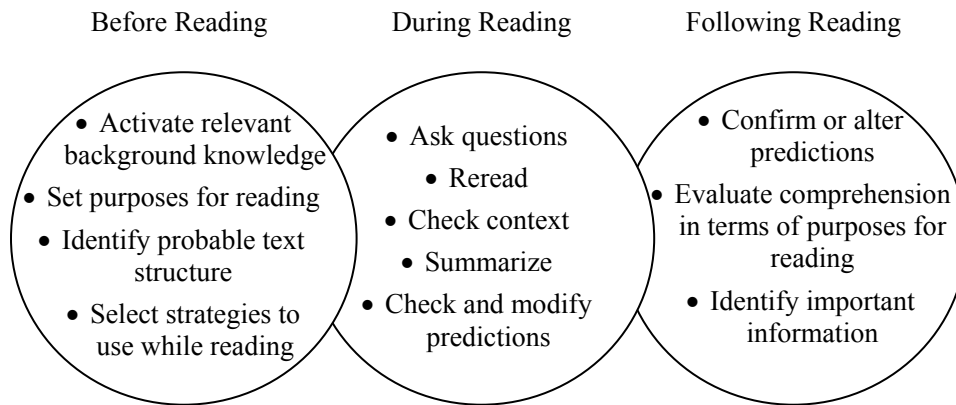


Figure 2. Strategies that Proficient Readers Use in the Activity of Reading<sup>2</sup>.

CARS must be explicit, multiple, and accountable for motivation. Reading strategy instruction provides significant gains, even for higher reading level students. Evaluating strategy intervention with 98 8<sup>th</sup>-grade students, Mothus (2004) found that students participating in the intervention had a significant increase in comprehension achievement scores of more than one grade level. Simmonds (1992) determined that reading strategy instruction improved comprehension by nearly two standard deviations among 240 resource room students in grades one through nine. While these studies have focused on the use of CARS with younger students, few experimental studies have been conducted in secondary classrooms or in career and technical education.

Effective reading relies not upon a single strategy, but incorporates the coordination of several strategies (Bulgren & Scanlon, 1997-98; Pressley & Wharton-McDonald, 1997; Taraban, Rynearson, & Kerr, 2000; Vaughn, Klinger, & Bryant, 2001). Morgan and Hosay (1991) determined that teaching a package of reading strategies improved comprehension, led Virginia high school students to read more, enhanced critical reading, increased the variety of texts read, and improved standardized test scores. Weedman (2003) determined that higher comprehension

<sup>2</sup> Ryder, R. J., & Graves, M. F. (1994). *Reading and learning in content areas*. New York, NY: Macmillan College Publishing Company, Inc.

scores were generated when teaching 9<sup>th</sup>-grade students to use a package of strategies.

Motivation also impacts whether and how students use comprehension strategies (Dole, Brown, & Trathen, 1996; Guthrie et al., 1995), and may have an impact on whether and to what extent a student reads. Exploring the relationship between motivation and reading comprehension in 55 10<sup>th</sup>-graders, Knoll (2000) found a strong relationship ( $r = .73$ ) between motivation and reading comprehension. Studying 90 7<sup>th</sup>-, 8<sup>th</sup>-, and 9<sup>th</sup>-grade students, Choochom (1995) concluded that intrinsically motivated students employed more strategies, exhibited greater self-regulation, and comprehended more text. In qualitative interviews of 14 college students, Van Zile-Tamsen (1996) found that content interest motivated students to self-regulate and use strategies. Still, little research exists about the impact of CARS instruction on students' actual reading behaviors.

### **Problem Statement and Research Question**

With the potential to impact over 1.2 million agricultural science students possessing a wide range of comprehension abilities, the goal of this research was to develop effective classroom strategies to improve reading comprehension skills. Agricultural science is an especially compelling context for reading because of the global nature of concepts, the complexity of those concepts, and the difficulty and diversity of textual sources of information. As the world's population continues to increase, providing safe, abundant, and ethical supplies of food, fiber, and renewable energy to *all* people, while also maintaining the sustainability of the planet, is the nexus for all of agriculture. Students enrolled in agricultural science are the future decision-makers and problem solvers of agriculture. Students must evaluate information and decisions emerging from that information from many perspectives.

The overarching research question for career and technical education addressed in this study was "How can career and technical education teachers use their instruction to improve students' comprehension of subject matter and motivation to read, in order to contribute to students' overall academic achievement?" Currently, little to no research exists in career and technical education research; whereby, a study compares the implementation of CARS in a planned, systematic, and thoughtful manner versus a teacher's own intuition about when and where to implement learning strategies in the lesson. The specific research question is, therefore, "What is the effect of instruction with CARS on students' content comprehension and motivation to read?"

### **Purpose and Hypotheses**

The purpose of this study was to explore the effects of CARS instruction on student comprehension of agricultural science content and motivation to read in



career and technical education, specifically agricultural science. The hypotheses of this study were:

- H<sub>1</sub>: Agricultural content posttest scores will be higher for students instructed with CARS than those students instructed with the teachers' normal routine of instruction.
- H<sub>2</sub>: Students' motivation to read, as measured by their reading behaviors, will be greater for students for students instructed with CARS than those students instructed with the teachers' normal routine of instruction.

## Methods and Procedures

### Research Design

A variation of the nonequivalent-control-group-design (Campbell & Stanley, 1963; Gall, Gall, & Borg, 2003) was used in this study. Independent variables were implicit instruction using CARS versus the teachers' normal instructional routine. CARS included reading strategies within each of the three micro-periods of reading, such as using K-W-L, graphic organizers, discussion webs, and summarization strategies. The teachers' normal routine of instruction was determined to be the comparison because of ethical reasons surrounding the idea of withholding instruction that could benefit students. Ethically, the researchers determined that withholding instructional methods beneficial to students' learning would be unethical and could inhibit the learning of those students in the comparison group. Therefore, teachers in the comparison group taught their lessons without the aid of professional development about learning strategies and without lessons with embedded CARS or any other learning strategy. They taught the lessons based upon how they normally would approach teaching these lessons.

The independent variable in the experiment was the activity associated with reading, namely the implementation of CARS. The dependent variables were the outcomes of the reading activity, specifically the students' agriculture content posttest scores and reading behaviors. Antecedent variables were the reader characteristics that included gender, grade level, ethnicity, socioeconomic status, and grade point average. FCAT reading level and agriculture content pretest score were also treated as covariates.

Gall et al. (2003) asserted that nonequivalent-control-group-designs could involve groups that all receive a treatment. This study used a variation of the design:

Treatment	O <sub>1</sub>	X <sub>CARS</sub>	O <sub>2</sub>
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Comparison	O <sub>1</sub>	X <sub>normal</sub>	O <sub>2</sub>

The first observation (O<sub>1</sub>) was an agricultural science content area pretest conducted during the week prior to initiating the study. CARS instruction served as the

experimental treatment ( $X_{\text{CARS}}$ ), while the teacher's normal routine served as the instruction for the "comparison" group ( $X_{\text{normal}}$ ). The second observation ( $O_2$ ) occurred at the end of the study 23 class days later, and consisted of the agriculture content posttest.

### Population and Sample

The target population was all students enrolled in the introductory agricultural science course, who were primarily, but not exclusively 9<sup>th</sup>-grade students. Because of uniformity of the curriculum in this course, the introductory agricultural science course was selected as the context. The nature of this study was not to examine career and technical education concentrators, those students who identify themselves as career and technical education students, but rather the impact of implementing the CARS intervention within a career and technical education course. The study used a sample from four Florida high schools. Teachers were selected purposively for their ability to deliver the treatment, gather data, and teach the prescribed content. Teachers, and their classes, were assigned randomly to either the treatment or comparison group. To ensure adequate significance level, statistical power, and analytic procedure, 47 subjects were required in each the experimental and control groups (Hays, 1973; Olejnik, 1984).

### Description of the Participants

Of the 95 students in the study, the majority ( $n=58$ ) were male. Fifty-five students (57.9%) were 9<sup>th</sup>-graders, 27 (28.4%) were 10<sup>th</sup>-graders, seven (7.4%) were 11<sup>th</sup>-graders, and six (6.3%) were 12<sup>th</sup>-graders (see Table 1). The treatment group included 8 minority students (17%), while the comparison group included 18 minority students (37.5%). In Florida, minority students comprise 48% of the student population. Minority students were those who self-classified into any of the non-White Caucasian categories as used by the University of Florida admissions criteria and those included American Indian/Alaska native, Black/African American, Hispanic/Latino(a), Asian, Hawaiian/Pacific Islander, and Other. Socioeconomic status was determined using a proxy—free and reduced lunch counts. If a student qualified for the school's free or reduced lunch program, then it was assumed that the student was of a lower socioeconomic status (Hauser, 1994; Malecki & Demaray, 2006). This information was provided by the school's guidance department. In the treatment group, 15 students (31.9%) qualified for free or reduced lunches, while in the comparison group, 19 students (40.4%) did so. The state average for free or reduced lunch counts is 45.2% (Edweek, 2006).

The mean grade point average was 2.62 on a 4-point scale. Overall, a majority of students ( $n=58$ , 61.1%) had a cumulative A or a B average in all classes (see Table 1). The mean state standard reading score was 1773.5 and the mean corresponding

FCAT Achievement Level was 2. Sixty students (69%) read at the lowest two FCAT levels, indicating they were reading below grade level.

Table 1

*Descriptive Statistics about Students' Gender, Minority Status, Free or Reduced Lunch Count, Grade Level, Cumulative Letter Grade, and Florida Comprehensive Assessment Test (FCAT) Reading Level*

	<u>Treatment</u>		<u>Comparison</u>		<u>Total</u>	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
<u>Gender</u>						
Female	14	29.8	23	47.9	37	38.9
Male	33	70.2	25	52.1	58	61.1
<u>Minority Status</u>						
White	39	83.0	30	62.5	69	72.6
Other ethnicity	8	17.0	18	37.5	26	27.4
<u>Qualified for Free or Reduced Lunch</u>						
Not qualified	32	68.1	28	59.6	60	63.8
Qualified	15	31.9	19	40.4	34	36.2
<u>Grade Level</u>						
9	33	70.2	22	45.8	55	57.9
10	10	21.3	17	35.4	27	28.4
11	1	2.1	6	12.5	7	7.4
12	3	6.4	3	6.3	6	6.3
Total	47	100.0	48	100.0	95	100.0
<u>Cumulative Grade Point Average</u>						
A (3.3 – 4.0)	5	10.6	6	12.5	11	11.6
B (2.3 – 3.29)	20	42.6	27	56.2	47	49.5
C (1.3 – 2.29)	13	27.7	12	25.0	25	26.2
D (.3 – 1.29)	8	17.0	3	6.3	11	11.6
F (< .3)	1	2.1	0	---	1	1.1
Total	47	100.0	48	100.0	95	100.0
<u>FCAT Reading Level</u>						
5	0	---	2	4.3	2	2.3
4	5	12.5	4	8.5	9	10.3
3	7	17.5	9	19.1	16	18.4
2	8	20.0	12	25.5	20	23.0
1	20	50.0	20	42.6	40	46.0
Total	40	100.0	47	100.0	87	100.0

### **Florida Comprehensive Assessment Test**

The Florida Comprehensive Assessment Test (FCAT) is part of Florida's initiative on educational accountability and raising overall educational achievement. Scores on the FCAT are reported for each student showing "achievement levels, scale scores, and developmental scale scores...as well as performance on specific content strands; each student's norm-referenced scores indicate the student's ranking against national norms" (FDOE, 2004d, p. 8). Students must pass the reading and writing portions of the test before they graduate. The reading portion of the FCAT is presented at the reading level of the grade and determines students' achievement in reading comprehension (FDOE, 2001). The 8<sup>th</sup>-grade FCAT reading test consists of 40% narrative text and 60% informational, or expository text. The 8<sup>th</sup>-grade FCAT reading assessment contains multiple-choice, short-response, and extended-response items. The 9<sup>th</sup>-grade FCAT reading assessment contains multiple-choice items, only. Questions on the reading portion of the test are drawn from "social studies, science, math, reading, health/physical education, the arts, and the workplace" (FDOE, 2004d, p. 10). The FCAT reporting scale is set to a mean of 300 with a standard deviation of 50, which spreads student scores along a scale from 100 to 500.

For reading, students are assigned to one of five reading levels. The definition of the FCAT reading levels are

1. Reading level 5 was the level that "indicates that the student has success with the most challenging content of the Sunshine State Standards" (FDOE, 2004e, p. 4).
2. Reading level 4 was the level that "indicates that the student has success with the challenging content of the Sunshine State Standards" (FDOE, 2004e, p. 4). This is the first level of reading above grade level.
3. Reading level 3 was the level that "indicates that the student has partial success with the challenging content of the Sunshine State Standards, but performance is not consistent" (FDOE, 2004e, p. 4). This is generally considered reading at grade level.
4. Reading level 2 was the level that "indicates that the student has limited success with the challenging content of the Sunshine State Standards" (FDOE, 2004e, p. 4). This is generally considered reading below grade level.
5. Reading level 1 was "indicates that the student has little success with the challenging content of the Sunshine State Standards" (FDOE, 2004e, p. 4).

## Intervention

Students were taught three animal science lessons from the state approved curriculum and included anatomy and physiology, nutrition, and reproduction. The lessons were taught over the course of 23 school days, or nearly 1600 minutes of instruction. The text used was *Agriscience: Fundamentals & Application* (Cooper & Burton, 2002). Text readability was ascertained using the Fry method (Fry, 1977), which yielded a grade level 13. Chapters and reading passages were selected to coincide with the individual lessons about anatomy and physiology, nutrition, and reproduction.

Treatment group teachers were instructed where and how to use CARS within their lessons, so that CARS were implemented in a systematic, planned, and thoughtful manner. Teachers in the treatment group participated in two hours of professional development at the state agriculture teachers' conference during the summer prior to the intervention. Further, their lessons were designed specifically with CARS embedded within the lesson. For each objective in the lesson, treatment group teachers were instructed to choose between two or more complementary strategies when instructing students to read. The lessons contained actual references to reading passages in the text, directions for specific CARS, and examples of the CARS in use for the objective. Further, the researchers followed up with each teacher prior to initiation of the treatment, as well as during the treatment, to provide support for implementation of CARS. CARS used by the treatment group included pre-reading strategies, including K-W-L<sup>+</sup>, *Making Predictions A → Z*, anticipation guides; during reading strategies, including think-aloud protocols and graphic organizers; and post-reading strategies, including summaries, discussion webs, and the *Cube It!* strategy. Each lesson contained one or more strategies for use during each of the micro-periods of reading. Teachers in the treatment group used an average of 16.5 CARS and taught for 1,570 minutes.

With no prompting from the researchers or the curriculum, teachers in the comparison group implemented learning strategies based upon their knowledge of and preference for using them. Additionally, no support from the researchers was provided to these teachers for implementation of any learning strategies. The teachers used an average of 29.5 different learning strategies and taught for 1,110 minutes. Learning strategies used by teachers in the comparison group most often included notes, organizers, Kagen structures, cooperative activities, concept mapping, prediction guides, Internet searches, demonstrations, discussions, chunking reading assignments, think-pair-shares, and summaries of reading. Much of the impetus for professional development about using learning strategies was developed through local school in-service and professional development workshops. Specific CARS, such as the K-W-L<sup>+</sup>, anticipation guides, discussion webs, graphic organizers, *Cube It!* strategy, and specific summary strategies were not used by the comparison group teachers.

## Instruments

**Agriculture Content Knowledge.** In order to control for preexisting agricultural content knowledge, an agricultural content knowledge pretest was adapted from existing assessments found in the Florida Agriscience Foundations Lesson Plan Library (FDOE, 2003). This test also served as the posttest at the conclusion of the treatment period. A panel of experts, consisting of teachers, faculty, and graduate students in agricultural education, evaluated the pretest and posttest to ensure face and content validity.

Comprehension of agricultural science concepts was measured using the pretests and posttests for each of the three lessons in the unit on introductory animal science. The tests, which are standard on agricultural science curriculum of this nature, consisted of five parts: (a) 10 matching items, (b) six to 15 one-word completion items, (c) one to three short answer essay questions, (d) 10 to 15 multiple-choice response items, and (e) a comprehension assessment. The comprehension assessment for two of the tests asked students to read a passage related to the lesson, and then create a concept map about their comprehension of the material. For the third test, the comprehension assessment asked the students to read a passage and then write a summary of the passage. Grading rubrics were provided to each teacher for scoring all items on the test. Post hoc reliability was assessed using the Kuder-Richardson 20 (coefficient alpha = .87).

**Motivation to Read.** Data regarding motivation to read were gathered using a researcher-derived instrument. The instrument was evaluated for face and content validity by a panel of experts including reading specialists and teacher educators. It asked respondents to answer two questions related to: (a) the number of books they had read in the previous month, and (b) the time spent reading for school and pleasure in the past week. These were all items for which respondents had “an accurate, ready-made answer” (Dillman, 2000, p. 37). The items did not require considerable thought, or variation, and posed no considerable reliability risk.

## Findings

**H<sub>1</sub>:** Agricultural content posttest scores will be higher for students instructed with CARS than those students instructed with the teachers’ normal routine of instruction.

Overall, students correctly answered 37.6% of pretest questions and 60.4% of posttest questions. The difference between the groups in the proportions of students answering questions correctly was not significantly different. On the pretest and posttest, students in the treatment correctly answered 37.9% and 59.2%, and students in the comparison correctly answered 37.3% and 61.5%, respectively. These figures represented no significant difference with an alpha level of .05.

For dichotomous variables, a dummy coding was utilized. Students in the comparison group, who were female, a minority, and/or qualified for the school’s

free or reduced lunch program were coded higher than students in the treatment group, who were male, white, and/or did not qualify for the free or reduced lunch program, therefore, indicating high socioeconomic status. Positive correlations would be indicated if the participant was in the comparison group, female, minority, and/or participated in a free or reduced lunch program. These data would, therefore, indicate lower socioeconomic status. Before inferential analysis of any of the variables, they were examined for possible correlations (Miller, 1998). The conventions proposed by Davis (1971) were used to indicate the magnitude of the correlations.

Substantial positive correlations were found between FCAT reading level and the pretest and posttest scores (see Tables 2 and 3). Substantial positive correlations also existed between the agriculture pretest and posttest. Moderate positive correlations were discovered between grade point average and the posttest, FCAT reading level, and pretest. A moderate positive correlation was observed between gender and both the posttest and grade point average. Moderate positive correlations were also observed between grade level and ethnicity. Low positive correlations were discovered between the treatment group and grade point average and ethnicity. Low positive correlations were also observed between ethnicity and socioeconomic status and between gender and FCAT reading. A low negative correlation was observed between ethnicity and the posttest.

Table 2  
*Correlations between Continuous Variables*

	1	2	3	4	5
1. Grade level	---	.18	-.07	.03	.04
2. Grade point average		---	.42*	.38*	.40*
3. FCAT reading level			---	.61*	.66*
4. Pretest				---	.66*
5. Posttest					---

\*  $p < .05$ .

In Hypothesis 1, the impact of CARS instruction versus the teachers' normal routine of instruction was compared. Thus, the first step was to describe the variance in posttest scores explained by the linear combination of treatment group, grade level, gender, ethnicity, socioeconomic status, grade point average, FCAT reading level, and pretest scores of students. Backward stepwise regression was used to select

the most appropriate model for explaining the posttest scores based upon the variables (Agresti & Finlay, 1997). Backward regression was used because of its power to construct a model using only those factors that contribute significance to explaining the dependent variable (Gall et al, 2003). Variables initially included in the model were treatment, gender, grade level, ethnicity, socioeconomic status, grade point average, FCAT reading level, and pretest score. Variables required an alpha level of .05 or lower significance to enter the regression equation, while variables with an alpha level of .10 or higher were removed.

Table 3  
*Point Biserial Correlations between Categorical Variables*

	Treatment Group	Gender	Ethnicity	SES
Grade level	.20	-.02	.29*	-.14
Grade point average	.23*	.33*	-.08	-.14
FCAT reading level	.06	.23*	-.02	-.04
Pretest	-.02	.09	-.09	-.20
Posttest	.06	.33*	-.26*	-.14

\*  $p < .05$ .

The regression analysis produced a model consisting of the linear combination of FCAT reading level, grade point average, pretest, grade level, ethnicity, and gender (see Table 4) to explain the posttest score,  $F_{(85)} = 27.26$ ,  $p < .05$ .  $R^2$  for the model was .67, and the adjusted  $R^2$  was .65. The linear combination of these variables explained 65% of the variance in the posttest score. Forward stepwise regression was used to determine  $R^2$  change, or additional variance explained by each factor. FCAT reading level explained the most variance (44%). Grade point average explained 12.1% of the variance, the pretest explained 4.9%, grade level explained 2.4%, ethnicity explained 2.1%, and gender explained 1.9%. Because the treatment variable was not included in the overall regression model, Hypothesis 1 was rejected. Also, since no significant difference existed between the treatment and the comparison group scores, no effect size was calculated.



Table 4  
*Backward Regression Analysis to Predict Posttest Score<sup>a</sup>*

	<i>B</i>	<i>SE</i>	$\beta$	<i>t</i>	<i>R</i> <sup>2</sup> change
(Constant)	-.09	.13	---	-.66	---
FCAT reading level*	.06	.01	.36	4.12	.440
Grade point average*	.05	.02	.24	2.99	.121
Pretest*	.36	.11	.29	3.41	.049
Grade level*	.04	.01	.17	2.41	.024
Ethnicity*	-.08	.03	-.19	-2.84	.021
Gender*	.06	.03	.15	2.16	.019

Note. <sup>a</sup>Adjusted  $R^2 = .65$  ( $p < .05$ ).

\*  $p < .05$ .

**H<sub>2</sub>:** Students' motivations to read, as measured by their reading behaviors, will be greater for students instructed with CARS than those students instructed with the teachers' normal routine of instruction.

On the pretest, 29 students (31.5%) indicated that they were currently reading a book, while 27 students (30.7%) indicated they were reading a book at the end of the study. In the treatment group, 12 students (26.7%) indicated they were reading a book during the pretest period, while the number of students increased to 16 (36.4%) who were reading a book during the posttest phase. In the comparison group, 17 students (36.2%) indicated that they were reading a book at the beginning of the study, but declined to 11 students (25%) at the end of the study.

The pretest and posttest asked participants to report the number of books that they had read during the previous month, time per week of school reading, and time per week of pleasure reading (see Table 5). Overall, students did not read significantly more books at the end of the study (1.74 books during the previous month at the beginning versus 1.78 at the end). At the beginning of the study, they read 3.44 hours per week for school compared to 3.70 at the end, and 1.94 hours for pleasure compared to 2.01 hours at the end. However, there were changes within the groups. The treatment group increased the number of books read in the previous month from 1.40 prior to the study to 1.80 at the end. They also increased the time spent reading for school from 3.42 to 3.74 hours per week. They significantly increased the time spent in pleasure reading from 1.33 to 2.57 hours per week.

Students in the comparison group decreased the number of books read in the previous month from 2.07 prior to the study to 1.76 at the end. They also decreased the time spent reading for school from 3.45 to 1.71 hours per week, and decreased the time per week spent reading for pleasure from 2.52 to 1.47 hours per week. At the end of the study, the difference between the groups on school reading was significant ( $\alpha \leq .05$ ). Cohen's  $d$  (1992) was .47 and the effect size was .23.

Table 5  
*Reading Habits of Students*

Habit	<u>Treatment</u>			<u>Comparison</u>			<u>Total</u>		
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>
<u>Pretest</u>									
Books per month	46	1.40	1.71	47	2.07	4.17	93	1.74	3.20
School reading (hrs./wk.)	43	3.42	4.17	47	3.45	5.49	90	3.44	4.88
Pleasure reading (hrs./wk.)	44	1.33	2.47	47	2.52	5.61	91	1.94	4.40
<u>Posttest</u>									
Books per month	44	1.80	2.13	45	1.76	3.02	89	1.78	2.60
School reading (hrs./wk.)	43	3.74*	5.58	45	1.71*	2.42	88	2.70	4.37
Pleasure reading (hrs./wk.)	44	2.57	5.05	47	1.47	3.23	91	2.01	4.23

\*  $p < .05$ .

Comparing the change in reading habits of students, students in the treatment group increased the time per week that they read for pleasure significantly more than the comparison group ( $p \leq .05$ ). The treatment group increased the hours per week reading for pleasure by 1.35 hours, while the comparison group *decreased* the time per week reading for pleasure by 1.14 hours (see Table 6). With 95% confidence, students in the treatment group read for pleasure between .39 and 4.57 hours more per week than students in the comparison group. Cohen's  $d$  was .51 and the effect size was .25.

Table 6  
*Change in Reading Habits of Students*

Habits	<u>Treatment</u>			<u>Comparison</u>			<i>t</i>	<i>p</i>	Confidence Interval
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>			
Books/month	43	.56	1.69	44	-.22	3.25	1.39	.17	(-.33, 1.88)
School reading (hrs/wk)	40	.60	6.87	44	-1.92	5.83	1.81	.07	(-.25, 5.27)
Pleasure reading (hrs/wk)	41	1.35*	5.03	44	-1.14*	4.67	2.36	.02	(.39, 4.57)*

\*  $p < .05$ .

### Discussion, Conclusions, Implications, and Recommendations

#### Participants and Their Reading Abilities

The majority of the students in this study were 9<sup>th</sup>-grade students (57.9%), male (61.1%), white (72.6%), and did not qualify for lunch subsidies (63.8%). The overall grade point average for the 95 students was 2.62/4.00, or “B-.” Sixty-nine percent of the students in the agricultural science courses read below grade level, which is similar to the 73% of students who read below grade level in the general school population of the schools tested (FDOE, 2004a, 2004b). Only 31% of the students in the study read at or above grade level, indicating that many students had “limited” or “little” success reading (FDOE, 2004b). Further, while students read below grade level, their individual cumulative grade point averages suggest that poor reading ability may not hinder earning high grades. This finding may suggest several confounding variables regarding teachers’ use of reading in secondary classes. First, teachers may be enabling students to learn without requiring them to read. Teachers may not require reading in their assessments of student learning. Students may have learned how to cope with learning, or at least earning passing marks, without actually reading in career and technical education courses.

When instructed to read a career and technical education text, many students (69% in this study) lacked complete understanding of the text. Reading problems are further compounded by the diversity and complexity of reading material encountered by students in career and technical education courses (Alexander & Kulikowich, Bintz, 1997; Cresson, 1999; Digisi, 1993; Kim et al, 2004; Menke & Davey, 1994; Vacca, 2002a). The difficulty of career and technical education texts was demonstrated by the text selected for use in this study which had a readability level suitable for college freshmen (Fry, 1977). Difficult career and technical education texts pose inherent challenges to learning and could explain some of the frustrations

that students and teachers feel when attempting to read, comprehend, and learn from the text. By implementing CARS, agricultural science teachers and career and technical education teachers may be able to help students activate relevant background knowledge, set purposes for reading, organize information, and summarize content in order to solve problems in the field.

### **Teacher Implementation of CARS and Learning Strategies**

Teachers in the treatment group used 16.5 CARS and taught the three animal science lessons for a total of 1,570 minutes. Teachers in the comparison group used 29.5 different learning strategies and taught the three lessons for 1,110 minutes. While not a specific objective of this study, it is interesting to note that the teachers in the comparison group implemented nearly twice as many learning strategies as teachers in the treatment group. Yet, while implementing nearly twice as many learning strategies, comparison group teachers taught for nearly 30% less instructional time than treatment group teachers. In essence, teachers in the treatment group used one CARS per 95 minutes of class time, while teachers in the comparison group used a learning strategy of some type every 38 minutes of class time.

What was the impact of more learning strategies on students' comprehension and motivation to read? This research did not specifically address the learning strategies used by teachers in the comparison group. Future research in career and technical education should be conducted to determine the appropriateness of multiple learning strategies in instruction. Areas of career and technical education are applied sciences, where teachers use reading and literacy to learn, apply, and solve problems. Perhaps, a *few* literacy tools would be more effective or at least as effective for student learning and achievement as a large cadre of strategies.

While the initial target population of the intervention in this study was students in career and technical education courses, the observation regarding how many CARS and learning strategies teachers in both groups implemented was an interesting finding. It provides the relevancy of conducting this study within the career and technical education context. Career and technical education teachers have traditionally perceived their disciplines as "hands-on;" therefore, reading was unnecessary or at least secondary to learning in career and technical education (O'Brien & Stewart, 1990). With the increasing availability of information from multiple genres of text in career and technical education, today's students must be adept at constructing meaning from those texts. A single textbook is not sufficient in today's career and technical education course. Therefore, teachers must assist students in learning how to read and comprehend from multiple sources of information.

As standardized testing will likely continue in the secondary schools, career and technical education teachers will increasingly be called upon to demonstrate how their instruction and courses contribute to students' overall academic achievement.

As teacher educators prepare the next generation of teachers, they must know how academic literacy strategies impact learning in career and technical education. Also, when teacher educators have the opportunity to provide professional development for current teachers, they must be able to equip those teachers with the most effective strategies.

### **Effect of CARS Instruction on Students' Agricultural Science Comprehension**

Consistent with previous research, white, female (Donahue, Voelkl, Campbell, & Mazzeo, 1999; NCES, 2000, 2001; Pomplun & Sundbye, 1999; Wirt et al., 2004), upper grade level (McKenna & Robinson, 2002; Stanovich & Cunningham, 1993; Stewart & Tei, 1983) students who had higher cumulative grade point averages, FCAT reading levels, and agriculture content pretest scores (Alexander & Kulikowich, 1991) scored higher on the posttest. In this study, the treatment did not have a significant effect on comprehension when compared to the comparison group.

Possible explanations for why the treatment did not provide a significant difference from the control group include the high number of other learning strategies that comparison group teachers implemented and the short duration of the study, the short duration of teacher professional development, and the lack of assistance in schools from reading experts and coaches. In future studies of reading strategy use in career and technical education, the use of content area reading strategies should be compared to an actual control where students receive no assistance with their reading assignments. While this practice may be ethically challenging, the true magnitude of impact will not be known without comparing the intervention to a true control group. Further, because reading is a cognitive skill, students require a longer amount of time in which to refine that skill. Teachers may require more intensive professional development about the use of content area reading strategies, as well as additional assistance during the initial stages of using those strategies within their teaching. Additional time would also allow teachers to become more familiar with reading strategies and, therefore, improve their use in instruction.

While treatment was not a significant factor in explaining variance, this finding may have implications for teachers, especially when coupled with the rate of CARS use. The comparison group teachers implemented twice as many learning strategies as the rate at which treatment group teachers implemented CARS, yet their students performed at a similar level of comprehension. With career and technical education teachers' finite time for planning and delivering instruction, teachers may be wise to carefully consider how they implement CARS. It may be of less importance how many CARS are implemented, but rather where in the lesson and how they are implemented that makes the significant difference in student achievement. This is certainly an area for further research.

Implementing CARS in a systematic, planned, and thoughtful manner may save teachers time and effort and have positive impacts on students' reading behaviors. Based on the findings of this study, it could be concluded that career and technical education teachers can implement twice as many learning strategies in a less strategic manner and obtain the same results as those career and technical education teachers who fine-tune their instruction and use reading strategies in an explicit manner. Career and technical education teachers do not need more to do; therefore, implementing fewer strategic reading strategies could save time and be equally or more effective as implementing several strategies in the classroom.

### **Effect of CARS Instruction on Students' Motivation to Read**

Significant differences were noted in the self-reported reading behaviors of students between the treatment and comparison groups. Research (Choochom, 1995; Guthrie, 2001; Guthrie & Alao, 1997; Hurst, 2004; Knoll, 2000; Morgan & Hosay, 1991) has indicated that using strategies helps students develop confidence and efficacy in reading, motivation to engage in reading, and reading of a wider variety of texts. Students in the treatment group *increased* their time per week of pleasure reading, while the students in the comparison group *decreased*, contributing to a significant difference in time for pleasure reading at the end of the study. The effect sizes approached the medium range (Cohen, 1992). The changes in both areas, overall time of reading for school and the change time of reading for pleasure, were nearly 15 minutes per week. An increase of 15 minutes per week in reading for both school and pleasure could amount to nearly 18 additional hours of reading per year, which is quite substantial.

Students in the treatment group, where CARS were implemented in a systematic, planned, and thoughtful manner, allocated more time for school reading and increased the time that they allocated for pleasure reading. Comparison group teachers may have inadvertently diminished students' motivation to read by using too many learning strategies and/or poorly implementing them. Inappropriate implementation could include not making the strategies explicit for learning, poor timing of strategy implementation, and/or a lack of intensity of strategy use. Further study could help ascertain why students in the comparison group diminished their reading behaviors.

Career and technical education teachers, especially those in agricultural science, should consider the impact that their instructional routines have on students' motivation to read. Introducing a large number of strategies to students may have a negative impact on their reading behaviors. An explanation for this finding could be more systematic, planned, and thoughtful focus on reading among treatment group teachers. Depending upon the micro-period (International Reading Association, 1988; Ryder & Graves, 1994; Snider, 1989; Snow, 2002), teachers in the treatment group may have implemented CARS more correctly than teachers in the comparison

group implemented their learning strategies. Consequently, students were engaging with text for longer periods of time and in a manner that aided comprehension while improving their reading efficacy. For example, during the prereading micro-period, treatment group teachers chose between the K-W-L strategy and anticipation guides to activate background knowledge and develop student interest in reading. The teachers' appropriate use of these strategies may have contributed to students' increased reading behaviors for the treatment group.

### **Recommendations for Further Research**

This study catalyzes questions for further research within the realm of career and technical education, where reading and comprehension are vitally important to student learning. For example, what is the effect of systematic, planned, and thoughtful implementation of CARS in career and technical education on comprehension and motivation to read when compared to a defined control group? Further, what is the effect of CARS instruction on comprehension and motivation to read when students are exposed to the treatment over a longer duration, perhaps a year or more? Perhaps, more investigation is needed at the secondary level with respect to reading and literacy in career and technical education. Additionally, how effectively do agricultural science teachers implement CARS before and after professional development?

From this study, several recommendations come to light. First, teacher educators in career and technical education must work to educate current teachers and equip them with the CARS necessary to assist students in reading. Secondary administrators will increasingly demand that teachers demonstrate how their instruction and curriculum complements all students' academic achievement. Accordingly, career and technical education teachers will be required to demonstrate how they improve students' literacy and reading comprehension. One of the means of accomplishing this is through explicit instruction of career and technical education content with proven content area reading strategies.

In career and technical education, implementation of literacy and reading strategies mandates that current approaches to instruction be changed. The traditional "hands-on" mentality that is prevalent with secondary career and technical education teachers will not sufficiently educate today's students and adequately prepare them for success in tomorrow's world. Career and technical education teachers have an applied context in which to help students become lifelong learners. As lifelong learners, students must be literate in and about the areas of career and technical education. They must know how to use textual information to solve problems and make decisions about themselves, their careers, and their communities. Today's career and technical education demands that students and teachers proceed beyond the "hands-on" mentality, or at least access and use textual information.

To create a culture of literacy in career and technical education, reading strategy instruction should be implemented in teaching methods courses as proper approaches to instruction *in addition to* stand-alone courses. Additionally, teacher educators should deliver in-service and professional development workshops that introduce current career and technical education teachers to effective reading strategies that are relatively easy to implement. Further, teacher educators should explore how they model reading behaviors and use reading strategies with their pre-service teachers. Because many college courses rely heavily on reading as a means of learning, college faculty could model appropriate uses of reading methods of using text for learning to build future teachers' knowledge and use of strategies.

Changes may also be necessary with the current curricula used in agricultural sciences and other areas of career and technical education. New career and technical education curricula should be designed with embedded instruction about reading and literacy strategies. When implemented in a systematic, planned, and thoughtful manner according to the specific micro-periods of reading, reading strategies may save teachers time and improve reading behaviors. Therefore, curricula should be developed that incorporate CARS directly into lesson plans and student activities. Further, career and technical education teachers should participate in professional development that models CARS and shows where and how to appropriately implement them into lessons.

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